2000 Report to the NY State IPM Grants Program

DEMONSTRATION AND EVALUATION OF PEST MANAGEMENT ALTERNATIVES IN FINGER LAKES GRAPES

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Summary. Several small experiments and demonstrations supporting adoption of improved spray technology and pest management alternatives by Finger Lakes area grape growers were completed.

(1) Spray trials with an electrostatic sprayer (ESS) showed roughly comparable spray deposition and fairly comparable disease control to areas treated with a conventional airblast sprayer. In a spray rate reduction experiment with the ESS sprayer, control of powdery mildew and botrytis declined at 50% and 25% of labeled rates. This suggested that reducing rates with the ESS sprayer would not be advisable, despite potentially better coverage with the ESS sprayer at much lower spray volumes than with conventional airblast sprayer. The potential for new spray equipment to reduce drift and improve spray deposition was explored through three field demonstrations organized by the Finger Lakes Grape Program and Dr. Andrew Landers.

(2) Sprayable grape berry moth pheromones, if effective, would be more likely to be adopted by growers, who are resistant to hand-applied pheromone ties. Tests this year in three vineyards were inconclusive, due to a lack of grape berry moth pressure in both pheromone-treated and untreated blocks.

(3) Releases of predatory mites for controlling european red mites (ERM) were made in 10 vineyards, half of each treated with EBDC fungicides, and half of each block with no EBDC fungicides. Releases did not increase predator numbers over naturally-occurring levels, but pest mite ERM numbers were higher where EBDC fungicides had been used, due to the fungicide's effect on predatory mites. Predatory mites provide biological control of ERM, except where they are impacted by EBDC fungicides. By carefully modifying spray programs, growers can maintain biological control. Grape varieties differ in leaf pubescence (hairiness), and pubescent leaves harbor more predatory mites than glabrous (hairless) leaves.

(4) Replacing tomato-ringspot virus infected vines with grafted vines can restore productivity of hybrid grape vineyards. Experimental grafted vines planted in 1999 were tested for virus. All 68 samples tested negative for the virus. Continued periodic testing of grafted vines will be necessary to verify that they remain virus free in the field. Several commercial growers in the Finger Lakes are planting grafted vines as replacements in ringspot-infested blocks.

(5)Reducing the application rate of imidacloprid (Provado) by 50%, from 0.75 oz/acre to 0.375 0z/acre, had no effect on the level of eastern grape leafhopper suppression. It appears that reduced rates may save growers money without affecting the level of suppression provided by this new low-risk insecticide. Reducing the cost of application will allow growers to substitute provado for less-expensive but more toxic insecticides, many of which are at risk of cancellation following Food Quality Protection Act (FQPA) review.

(6)The striped snail, *Cepaea nemoralis*, has appeared as an unwanted contaminant in machine-harvested grapes, causing economic losses to growers due to processor rejection of snail-contaminated bins of grapes. Keeping snails out of the canopy is the key to preventing these losses. Insecticides are largely ineffective. 'Sluggo' brand bait, made of iron phosphate, proved as effective as metaldehyde bait, potentially toxic to wildlife, in keeping snails out of canopies. Copper based sprays directed at grape trunks, or copper barriers placed around trunks offer great promise in keeping snails out of grape canopies. Copper barriers appear to be 100% effective, and offer growers a simple, long-term, environmentally friendly solution for growers.

Full Report by Objective.

Objective 1. Evaluate and demonstrate novel sprayer configurations that reduce drift while maintaining spray coverage

The Finger Lakes Grape Program collaborated with Andrew Landers, Senior Extension Associate in Spray Technology and Dr. Wayne Wilcox, Dept. of Plant Pathology, to set up plots at Canandaigua Wine Company vineyards near Dresden, NY. The two trials compared spray deposition and disease control obtained with electrostatic spray system's (ESS) sprayer, recently purchased by Canandaigua, and a conventional airblast sprayer. Dr. Landers & Wilcox collected all data and evaluations in these trials.

Castel/Elvira Trial. In the first trial, on 'Castel' and 'Elvira' grapes, spray deposition in different areas of the canopy were measured through addition of Sequestrine® iron chelate (Fe) to spray solutions as a marker. The amount of Fe deposited on leaves in the top, middle, bottom and center of the canopy was measured following the spray applications.

Results showed lower overall rates of iron deposition with the ESS sprayer on 'Elvira' grapes, but roughly comparable deposition on the Castell block (Table 1).

Table 1. Iron (Fe) distribution following spray application of Sequestrine with ESS and conventional airblast sprayer

	Fe deposition (ppm)			
	Elvira Block		Castell Block	
Position	ESS	Air blast	ESS	Air blast
Top	9.61	9.61	10.81	4.06
Middle	16.09	32.12	18.14	21.95
Bottom	24.99	37.91	35.07	32.68
Center	30.89	41.63	30.17	49.79
Total	20.4	30.31	23.55	27.12

Data courtesy Dr. Andrew Landers

Disease ratings (Table 2) were made on the incidence of *Botrytis* bunch rot and foliar infections of powdery and downy mildew in the Castel block. Incidence and severity of foliar downy and powdery mildew were similar, while there was slightly higher botrytis incidence with the ESS sprayer.

Table 2. Botrytis and Foliar Downy and Powdery Mildew control in 'Castel' block comparison of Airblast and ESS sprayer.

		Foliar infection (PM + DM)	
Treatment	Botrytis (% clusters)	% Leaves	% Leaf area
AirBlast	22.7	42.0	2.4
ESS	29.3	36.7	2.3

Data courtesy Dr. Wayne Wilcox

Spray volume and reduced rates trial - Aurore block. One of claims of the ESS sprayer manufacturer is that better coverage obtained by electrostatic sprayers will allow rates of fungicides to be reduced, with no loss in efficacy. This was tested in the 'Aurore' block by applying 3 treatments: 100% of the recommended rates, 50% of recommended rates, and 25% of recommended rates. Disease ratings from this trial (Table 3) showed an increase in the incidence and severity of powdery mildew and botrytis cluster infections. For foliar powdery infections, incidence was similar for all treatments (close to 100%), and severity increased from 100 to 50% rate, but was similar for the 50 & 25% rates. Downy mildew incidence and severity was similar for all three treatments. Despite the differences observed among treatments, disease ratings showed relatively low incidence and severity, compared to what would be observed in an untreated check.

Table 3. Incidence and severity of *Botrytis*, powdery mildew and downy mildew in an Aurore block sprayed by the ESS sprayer using differing rates of fungicides in 2000.

	Cluster infections (%)[1]				Leaf infections (%)[2]			
	Powdery mildew		*Botrytis*		*Powdery mildew*		*Downy mildew*	
Treatment	Incid[3].	Severity[4]	Incid.	Severity	Incid.	Severity	Incid.	Severity
ESS-100% (A)	4.0	0.1	54.7	6.2	90.7	26.5	79.3	7.9
ESS-50% (B)	24.0	2.8	62.7	6.5	98.0	36.7	74.7	6.7
ESS-25% (C)	24.0	4.2	72.0	11.3	100.0	38.2	77.3	6.6

[1] Values represent means from 3 replications, 25 clusters/rep examined.
[2] Values represent means from 3 replications, 50 leaves/rep examined.
[3] Incidence = % clusters or leaves infected
[4] Severity = % surface area infected on clusters or leaves
Data courtesy Dr. Wayne Wilcox

Extension Meetings. The Finger Lakes Grape Program and Dr. Landers planned and scheduled three extension meetings demonstrating spray technology alternatives to Finger Lakes grape growers:

• **Electrostatic Spray Systems sprayer.** Canandaigua Vineyards, Dresden. Canandaigua's recently-purchased ESS electrostatic sprayer was demonstrated. This novel sprayer applies a charge to the spray stream for improved coverage and reduced spray volume (as low as 9 GPA). Andrew Landers, Canandaigua staff, and a representative from ESS demonstrated the sprayer. Andrew described his trials currently underway with the sprayer, and promised to share results in a future newsletter article. *Participants: A. Landers, ESS Representative, T. Collins, & B. Dunn.*

• **Vineyard Establishment and Lipco Tunnel Sprayer Demonstration.** Sheldrake Point Vineyards, Interlaken. In this twilight meeting, Dave Weimann, vineyard manager, and Bob Madill, general manager, described their use of laser planting, land leveling, and metal line posts for establishing 30 acres of vineyard in the past 3 years. Andrew Landers described, and Dave Weimmann demonstrated Sheldrake's LIPCO recirculating tunnel sprayer, which greatly reduces drift and can recirculate up to 30% of spray material applied. *Participants: Bob Madill & Dave Weimann,, Andrew Landers, & LIPCO sprayer representative.*

• **Fruit Field Day at Geneva.** August 17, NYS Agricultural Experiment Station, Geneva. This day-long tour for grape industry persons was part of a larger event with simultaneous apple, stone fruit, and small fruit tours. As part of this tour,, Dr. Andrew Landers led a demonstration of seven vineyard sprayers supplied and operated by manufacturers' representatives. For each sprayer, a 16' high pole with water sensitive paper was placed in the spray path to illustrate spray deposition. A tall frame with interspersed ribbons (the 'Jean Machine') was placed next to the sprayers before each demonstration to illustrate air flow from each sprayer. Finally, Dr. Landers demonstrated how addition of a simple baffle to direct air flow could be used to direct deposition of spray materials and reduce drift.

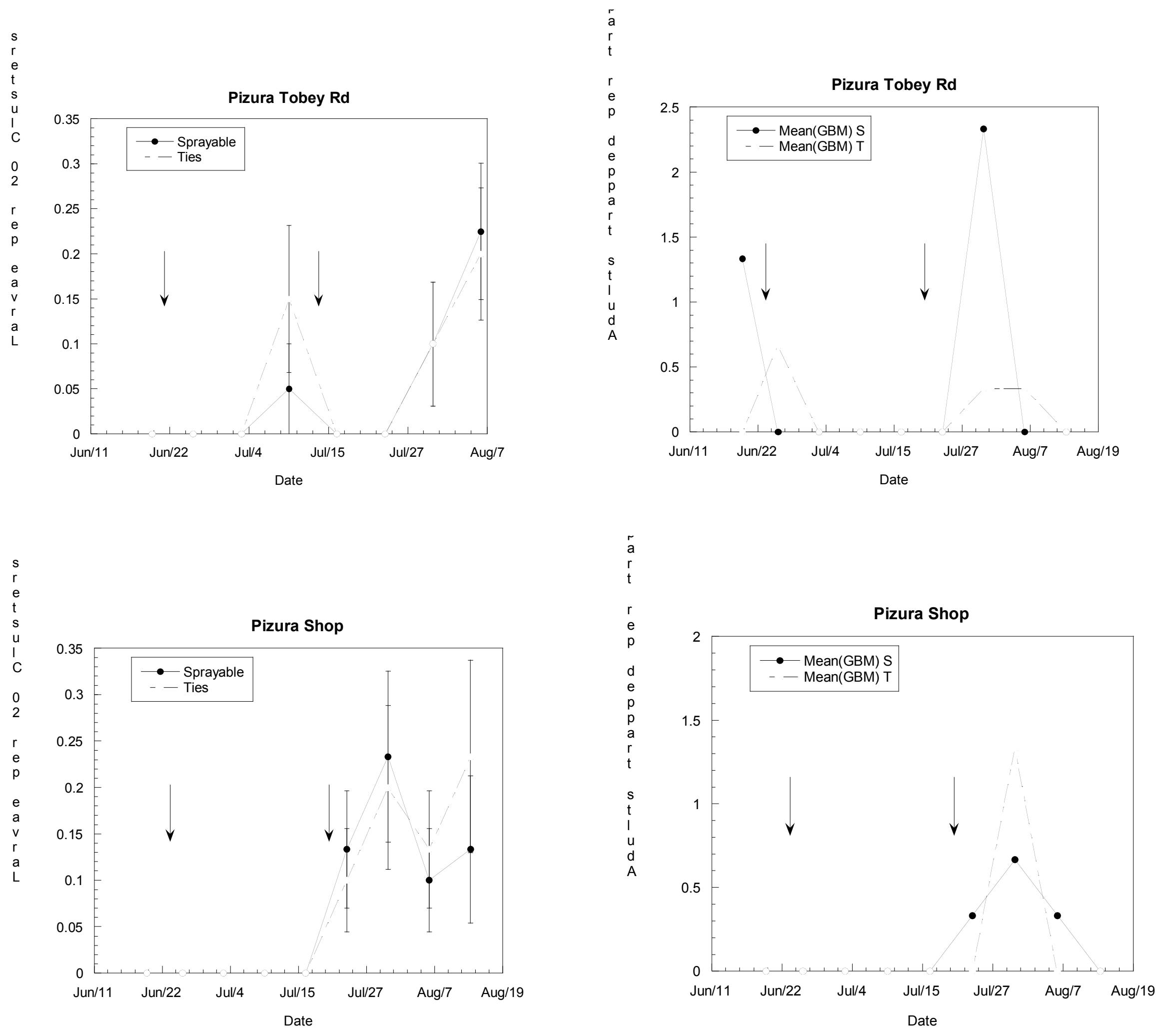
Objective 2. Evaluate efficacy of sprayable grape berry moth pheromone applications.

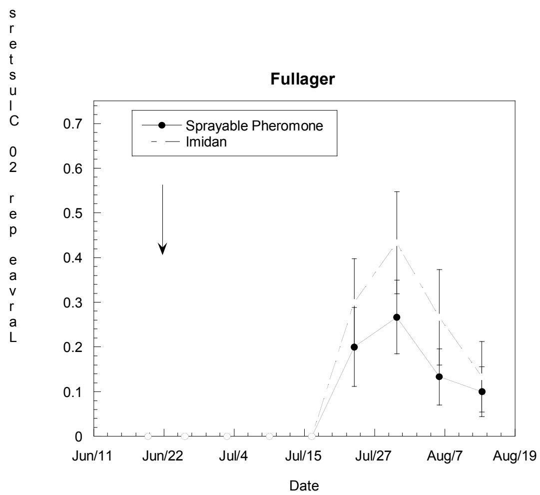
Methods. A new sprayable microencapsulated form of grape berry moth pheromone, developed by 3-M Canada for vineyard use, was tested in three Finger Lakes Vineyards. At the two Pizura sites (Tobey Rd and Shop), the sprayable formulation was paired with Isomate® GBM pheromone ties in adjacent blocks. At the Fullager site, the sprayable formulation was paired with an adjacent block treated at 10 days postbloom with Imidan at the maximum labeled rate. At the Pizura site, two applications of sprayable pheromone were made on June 22 and July 15. At the Fullager site, a single application was made on June 22. At each site, pheromone traps, baited with GBM pheromone, were placed at the vineyard edge, adjacent wooded edge, and 3 post-lengths into the vineyard. The number of male GBM adults trapped were counted weekly through mid August. In each plot, 20 clusters were sampled in four locations per plot weekly from June 22 through August 7. The number of larvae per 20 clusters were counted.

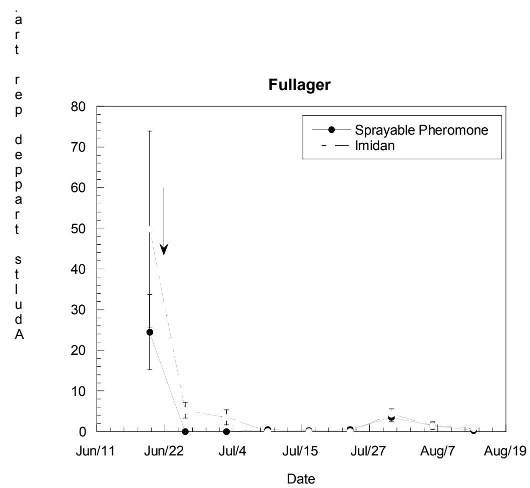
Results. At the Pizura sites, few adult moths were captured, even though the blocks had a history of heavy GBM infestations in previous years. At the Fullager site, trap catches were high during the initial sampling period, then low thereafter. Trap shutdown in the sprayable block was noted for 5 weeks after application. No significant differences were seen in fruit injury in the sprayable vs. pheromone tie or insecticide-treated blocks, and fruit injury was low - not exceeding 0.25 larvae per 20 clusters, or 1.25% cluster infection. These infestation levels were well below the 6-15% cluster incidence used as a treatment threshold in NY.

Significance. Pheromone ties aren't widely used for grape berry moth in NY, despite being available commercially since 1991. The time needed to apply them is a significant barrier to their adoption. If a sprayable formulation is available, growers will be more likely to use pheromone mating disruption to control grape berry moth. Results of these trials were inconclusive, due to lack of GBM pressure.

Figure 1. Cluster infestations of Grape Berry Moth (left) and pheromone trap catches (right) at two Pizura sites treated with sprayable pheromone vs ISOMATE-GBM pheromone ties, and at the Fullager site treated with either sprayable pheromone or Imidan.







<u>Objective 3. Evaluate establishment of *T. pyri* for European Red Mite and effect of EBDC fungicides on predatory mites in commercial-vineyard blocks.</u>

Effectiveness of mite biological control In 1999 we initiated an experiment to assess the impact of EBDC fungicide use on the predatory mite *Typhlodromus pyri*. Previous research has shown that application of these fungicides may prevent establishment of the predators and disrupt biological control. At each of 9 vineyard we established two plots, 0.5 to 1 acre each. One of these plots was treated with EBDC fungicides, the other with non-EBDC fungicides. No insecticides detrimental to *T. pyri* were used in either plot. Within each plot, 4 sub-plots were established that consisted of 3 panels in each of 3 rows. Into 2 of these sub-plots, *T. pyri* were released by affixing 50 apple flower blossoms to the vines in each panel. Inoculation was repeated by affixing 50 apples leaves to the grape leaves in each panel.

Commencing in early June and at approximately 14 day intervals, predator and pest mite numbers were measured in each subplot. Fifteen leaves were collected from each sub-plot and transported to the laboratory where mite numbers were estimated. This monitoring procedure was also conducted in 2000. Two vineyard were not monitored in 2000; one as a result of an erroneous insecticide application that decimated the predaceous mite population and one because the planted grape cultivar would be unlikely to harbor phytoseiids (see the second section below). Average seasonal densities of *T. pyri* and European red mite are shown in the Tables 1 and 2.

Table 1. Average seasonal densities of *T. pyri* in 7 vineyards with and with predator releases and with and without EBDC fungicide use.

	1999				2000			
	T. pyri released		T. pyri not released		T. pyri released		T. pyri not released	
Site	EBDC	no EBDC	EBDC	no EBDC	EBDC	no EBDC	EBDC	no EBDC
1	0.02	0.08	0.02	0.05	0.04	0.1	0.08	0.19
2	0.37	1.16	0.5	0.97	1.61	2.9	1.32	2.49
3	0.03	0.001	0	0.04	0.08	1.48	0.15	1.57
4	0.08	0.03	0	0.03	1.29[a]	0.67	0.98[a]	0.19
5	0.002	0.05	0	0.001	0.06	0.3	0.002	0.11
6	-	0.1	-	0.15	-	1.02	-	1.55
7	0.03	0.001	0.01	0.001	0.16	0.66	0.08	0.82

[a]No EBDC applied in 2000

Table 2. Average seasonal densities of European red mite (*Panonychus* ulmi) in 7 vineyards with and with releases of *T. pyri* and with and without EBDC fungicide use.

Site	1999				2000			
	T. pyri released		T. pyri not released		T. pyri released		T. pyri not released	
	EBDC	no EBDC	EBDC	no EBDC	EBDC	no EBDC	EBDC	no EBDC
1	0	0.005	0	0	0	0.005	0	0.004
2	0	0	0	0.005	0.009	0.005	0.004	0
3	0.004	0	0	0	0.23	0	0.23	0.009
4	1.23	1.58	1.6	2.92	0.06[a]	0.06	0.45[a]	0.37
5	0.88	1.14	1.6	1.96	0.002	0.007	0.31	0.17
6	-	0.73	-	0.76	-	0.014	-	0.014
7	1.6	0.4	2.18	0.54	13.23	0.8	10.13	1.58

[a]No EBDC applied in 2000

In 1999 there was no evidence that releases increased the numbers of *T. pyri*. There was some evidence (site 2) that EBDC fungicide applications reduced predator numbers approximately two fold. *Typhlodromus pyri* were found in all the plots regardless of release status and European red mite populations were quite low.

In 2000 there again was no evidence that release of the predators resulted in an increase in abundance. Densities of the predators were however considerably lower (2-8 fold) where EBDC fungicides were applied. Densities of European red mite were generally low; however, at two sites (3 and 7), pest mite numbers were considerably higher in EBDC treated plots. These results show that conserving *T. pyri* in grapes results in effective mite biological control.

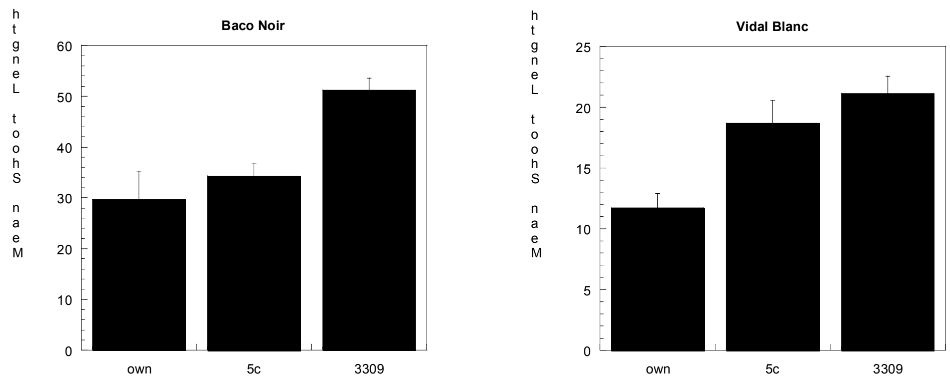
Influence of grape cultivar on *Typhlodromus pyri* Recent research has shown that *T. pyri* are more abundant on apple varieties with pubescent leaves compared to varieties with more glabrous leaves. Leaf trichomes have been shown to offer protection to *T. pyri* eggs against predation and leaves with abundant trichomes capture greater amounts of pollen, an important alternate food for *T. pyri*. We extended the study of leaf topography influences on *T. pyri* to grape leaves by performing counts of predators on different grape cultivars, and conducting experiments to study adult movement and oviposition behavior, and thrips predation on *T. pyri* eggs. Variation in numbers of *T. pyri* on different grape cultivars was related to the density of leaf trichomes and to the size of domatia. Analysis of predator counts over time showed that *T. pyri* densities varied among cultivars and over time; however, the numbers of mites on each cultivar relative to the other cultivars did not change. Laboratory experiments showed that *T. pyri* preferred leaves with domatia over leaves covered with felty, matted hairs and lacking domatia, and over leaves that were nearly glabrous. Leaf topography did not influence *T. pyri* oviposition rates. Leaf trichomes and domatia afforded predator eggs protection from thrips predation and the data suggest that this protection is obtained even from low densities of trichomes and small, poorly developed domatia. These data suggest that on grape cultivars lacking leaf trichomes and domatia, *T. pyri* probably will not attain sufficient densities to provide biological control.

<u>Objective 4. Continue evaluation of plantings of grafted vines as replacement for tomato ringspot-infested vines in local vineyards.</u>

Tomato Ringspot Virus affects several economically important wine grape varieties, among them Baco noir, Vidal blanc, and Dechaunac, causing gradual declines in yields as the area infected increases by 1% per year. Interplanting grafted vines into infested own-rooted area may allow growers to retain the productivity of vineyards, without replanting the entire vineyard. We have established plantings of own rooted and grafted vines in two vineyards, and a grower near Pulteney is attempting to renovate a vineyard with around 30% of the vines infected, with

Dresden experiment. Periodic testing of replanted vines is one way of determining whether this strategy will be cost-effective and work. This year, grafted and ungrafted Vidal blanc and Baco noir vines, planted in 1999 at Canandaigua's Dresden vineyards were tested by Dr. Dennis Gonsalves laboratory in Geneva. They ran ELISA tests on dormant vine cuttings, with appropriate infected controls, and reported the results to us. Twenty-two of the 68 samples (most from the Vidal block) were dead. The remaining samples all tested negative for TRSV. Shoot growth (Figure 2) was also measured in the experimental interplantings. In the 'Baco Noir' block, vines grafted to 3309 grew significantly more than either the 5C or own rooted vines. In the Vidal block, growth was much poorer, due to poor weed control. In this block, own rooted vines grew significantly less than either the 5C or 3309 vines.

Figure 2. Shoot length of own rooted vs vines grafted to '5C' and '3309' rootstocks planted in 1999 at Canandaigua Vineyards near Dresden, NY.



Grower Experience. A grower near Branchport replanted about 5% of his 2 acre 'Baco noir' block in 1999 with grafted vines, produced by neighboring grower Don Peak in 1998. Vines planted in 1999 survived and became established well; An additional 10% was replanted in 2000. Mr. Peek has produced several thousand grafted 'Baco noir' vines in 2000, grafted to various rootstocks, and is supplying several growers in the Keuka lake area with grafted replacement vines for renovating their vineyards.

Practical Significance. As prices for red hybrids have rebounded over the past few years, growers have an interest in preserving the productivity of their hybrid vineyards. The objective of our experiments was to verify that grafted vines could provide long term protection and be successfully established as interplanted vines. The answer is still open, but several growers are doing so in their vineyards. Continued monitoring over several years will be necessary to verify that this practice is useful.

<u>Objective 5. Evaluate reduced rates and tank mixes of imidacloprid for eastern grape leafhopper and grape berry moth control.</u>

Grape leafhoppers can cause significant injury to grapes in New York and elsewhere in the Northeast. The main species attacking concord grapes is the eastern grape leafhopper, *Erythroneura comes*, while several other *Erythroneura* species feed on hybrid and *V. vinifera* grapes. With changes in laws regulating pesticides and the development of insecticide resistance in some leafhopper populations, there is a need for new compounds and/or new ways of using currently registered compounds for the control of leafhoppers. In particular, Imidacloprid is registered for leafhopper use, but the expense ($30 / spray treatment) makes it uncompetitive with other currently available insecticides. Reducing the rate, while maintaining efficacy, would benefit NY growers while reducing insecticide use.

Methods. The field trial was conducted during the 2000 field season using a mature, commercial Concord vineyard located in the Lake Erie grape belt near Westfield, NY. The vines were planted with conventional row and vine spacing. The following spray treatments were randomly assigned to 3 panel replicates (3 vines per panel) spaced out within the vineyard using a random-block experimental design and 5 replicates per treatment: Avaunt WG (idoxacarb) at a rate of 4.8 oz product per A, Actara 25 WG (thiamethoram) at a rate of 1.5 oz product per A, Provado 75 WP (imidacloprid) at a label rate of 0.75 oz per A, Provado at half label rate of 0.37 oz per A, Sevin 80W (carbaryl) at a rate of 2.5 lb per A, Danitol 2.4 EC (fenrpopathrin) at a rate of 6 fl. oz per A, and a check. The center panel (3 vines) of each replicate was censused for leafhopper nymphs twice, once during the first generation (13 July) and a second time during the second generation (14 August). A census involved counting all leafhopper nymphs on leaves 3 through 7 for 5 shoots per vine and 3 vines per replicate. The insecticides were applied at approximately 10 days past the mid-bloom period (18 June) using a hooded boom plot sprayer at a rate of 200 gallons of water per acre.

Results. Leafhoppers were common on check vines within the experimental vineyard during the first leafhopper generation, although densities did not exceed the economic threshold of 5 nymphs per leaf. Because of the relatively cool, wet season, there was only a partial second generation of leafhoppers and densities of nymphs on check vines, as a consequence, were low. Density of nymphs on treated vines during the first and second generation were very low and statistically distinguishable from nymph densities on check vines indicating all tested materials and rates were effective (Table 1). We found no significant differences among the different treatments.

Table 1. Mean number of eastern grape leafhopper nymphs per leaf plus or minus 1 standard error during the first and second generation of the 2000 field season following treatment with different insecticides (1 postbloom application).

Treatment	Project Rate	LH nymphs/lf ± Std. Error (July)	LH nymphs/lf ± Std. Error (August)
Avaunt WG	4.8 oz/A	1.2 ± 0.44	0.3 ± 0.06
Actara 25WG	1.5 oz/A	0.01 ± 0.01	0.008 ± 0.005
Provado 75WP	0.75 oz/A	0.1 ± 0.05	0.01 ± 0.008
Provado 75WP	0.37 oz/A	0.08 ± 0.07	0.008 ± 0.005
Sevin 80W	2.5 lb/A	0.06 ± 0.06	0.01 ± 0.004
Danitol 2.4 EC	6 fl oz/A	0.0 ± 0.0	0.02 ± 0.01
Check		3.3 ± 0.62	1.3 ± 0.29

Objective 6. Test whether sucrose applied to grapes reduces bird injury.

This objective was not completed, because T. Martinson was called away on personal business during the time at which applications would be made.

Additional Objective: Preventing Striped Snails from Becoming Harvest Contaminants in Juice Grapes.

Note: The work described here was not included in the original grant proposal. However, the summer employee funded by IPM spent a significant amount of time on this pest-management related project, so I thought it appropriate to include it here - TEM

Striped garden snails, *Cepaea nemoralis,* have become important contaminants of juice grapes at harvest in certain areas (Niagara County, Canandaigua Lake, Ontario, CA) . The snails do not directly feed upon grapes, however they climb up into the grape canopy, where they are knocked off and into bins at harvest by mechanical harvesters. In 1999, we unsuccessfully tried various insecticide sprays as a management tactic, and did some preliminary studies to look at distribution within vineyards and basic biology. This year we tested several approaches to preventing snails from moving up into the grape canopy, including metaldehyde bait, iron-phosphate bait (Sluggo®) and using 1) copper bands placed on trunks, or 2) fixed copper fungicide sprays directed at trunks to prevent snails from climbing the trunks.

Methods. In a randomized complete block, four treatments were assigned randomly. Treatments were: Metaldehyde bait, Iron-phosphate bait, Copper bands around trunks (Figure 3), Champ (Copper hydroxide) applied in a concentrated slurry around the trunk, and an Untreated control. We collected snails and placed 5 snails at the base of one trunk of each of 3 vines per experimental unit. We then came back and counted the number of snails at the base of the vines and the number in the grape canopy.

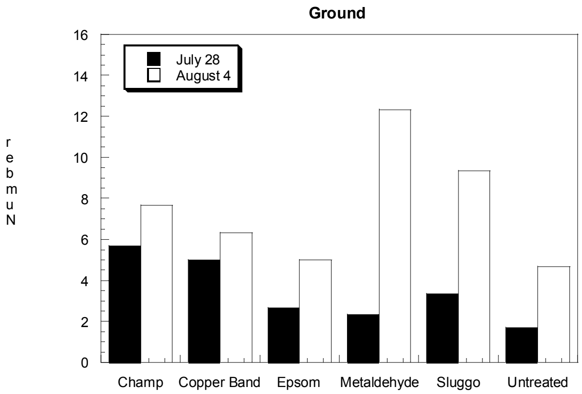
In addition to this trial, we also tested behavioral response of snails to the copper bands and trunks treated with 'Champ' by placing active snails on trunks treated with 'Champ' or on the copper bands, and observing each snail for 5 minutes following placement. Snails exposed to copper typically began to produce copious amounts of slime, retract, and fall off the trunks. We measured the amount of time elapsed between placement and this behavioral response.

Results. Snails observed at two and 9 days following treatment (Figure 4) in the canopy and on the ground differed significantly after treatment. In the Metaldehyde and Sluggo bait treatment, significantly more snails were found around the base of treated vines than in either the treated or copper (Champ, copper band) treatments. Nine days after treatment, all of these snails were dead. Both baits significantly reduced the number of snails in the canopy 9 d after treatment, compared to the untreated check. Champ and copper bands did not significantly change the number of snails found on the ground at either 2 or 9 d post treatment. Champ reduced the number of snails in the canopy 2 d after treatment, but not 9 d post-treatment. No snails were found in grape canopies where copper band barriers were placed.

Behavioral trials with the copper trunk spray and copper bands (Figure 5) showed a dose-related response to the champ trunk spray. At the 60 g/liter spray concentration, the average time until snails dropped was 200 seconds. At the 6.0 g/l concentration, snails remained on the trunk longer. Snails placed directly on copper bands remained for less than 30 seconds.

Practical Significance. Although snails currently affect a small portion of the acreage in the Finger Lakes, other infestations have been found in Niagara County, and on the Niagara peninsula in Ontario. Vineyards that have snails have had them over the past three years, and the risk of processor rejection is an economic threat to growers at the time of sale and delivery of their grapes. Killing snails with molluscicides or insecticides is impractical, because large reservoirs are often present in sod adjacent to vineyards. Use of copper-based fungicides, directed at trunks and row middles, or placement of copper bands on trunks can prevent snails from moving into the grape canopy and being harvested with the grapes. Copper bands, though initially expensive, should provide several years of protection.

Figure 3. Copper bands surrounding grape trunks and posts prevented *Cepaea nemoralis* from moving into grape canopies from the ground.



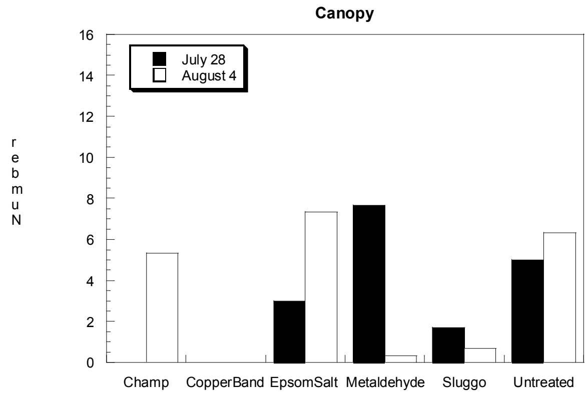


Figure 4. Number of snails found at 2 days (July 28) and 9 days (August 4) following treatment with various baits and repellents (copper compound, copper barriers).

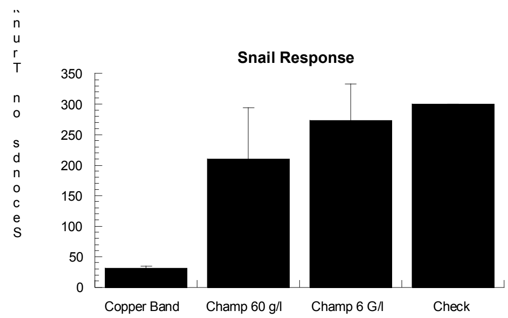


Figure 5. Time that snails remained on grapevine trunks treated with concentrated Champ or copper bands.